

## MEMORANDUM

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**To:** Chip Humphrey and Kristine Koch, U.S. Environmental Protection Agency, Region 10  
Karl Gustavson and Earl Hayter, U.S. Army Corps of Engineers ERDC

**From:** Kirk Ziegler, Li Zheng, and Fanghui Chen, Anchor QEA, LLC

**Date:** January 15, 2014

**Re:** Sediment Transport Modeling Analysis: Item 2 of EPA's Portland Harbor Feasibility Study Supplemental Information Requests

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The U.S. Environmental Protection Agency (EPA) requested in a November 20, 2013 email a supplemental modeling analysis be conducted using the Portland Harbor sediment transport model developed for the draft Feasibility Study (FS), designated as Item 2 in the request. This memorandum provides the requested information. The specific Item 2 request from EPA was:

Modeling Analysis - Please run the sediment transport model for the following events:

- Two-year event: Start the modeling on Jan 1, 2003. After 5 days of spin-up, start the sediment transport model and run it until February 28, 2003. Please provide hourly output of bed shear stress and critical shear stress values in each grid cell, and the values of bed shear stress and critical shear stress at time of peak flow on February 26th.
- Twenty-five year event: Please conduct a similar analysis on a period of the LWR hydrograph that encompasses a 25-year flood event, and provide similar output.

The overall objective for this request is to assess the potential for erodibility under various stage floods.

The purpose of this memorandum is to describe the flood events and the relevant model output being provided to EPA. After reviewing U.S. Geological Survey (USGS) flow rate data for the Lower Willamette River (LWR) during January and February 2003, it was determined that the peak flow rate of the 2-year flood discussed by EPA occurred on February 1, 2003, not on February 26, consequently the information provided straddles the February 1 peak flow (Figure 1). In addition, a review of USGS flow rate data indicated that a 25-year flood occurred during January 1997. Both of these floods had been previously simulated using the LWR hydrodynamic and sediment transport models for a 30-year period that included 1997 and 2003. Thus, new model simulations did not need to be set up and conducted to provide the information requested by EPA. During a discussion with Karl Gustavson and Earl Hayter, it was determined that providing hourly output of model results during a 3-day period for each flood event (i.e., 1 day before peak flow, 1 day during peak flow, and 1 day after peak flow) would be useful for their needs.

During a phone conversion on December 13, 2013, Karl Gustavson and Earl Hayter indicated that EPA is planning to use the model results to conduct some type of bed stability analysis based on comparisons of predicted bed shear stress and critical shear stress during these two floods. This type of analysis can provide preliminary insights about locations in the LWR where

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erosion may occur during 2-year and 25-year floods. However, results of this type of simplified analysis cannot be used to reliably determine estimates of scour depth or quantify the potential for remobilization of buried contaminants. A more reliable and accurate method for evaluating bed stability is to use the LWR hydrodynamic and sediment transport models to simulate the 2-year and 25-year floods. These simulations have already been conducted by Anchor QEA and the model inputs and setup were provided to EPA through emails on September 14, 2011.

## **2-YEAR AND 25-YEAR FLOODS IN THE LOWER WILLAMETTE RIVER**

A summary of the estimated flow rates for high-flow events in the Lower Willamette River is presented in Table 1 (Portland Harbor RI/FS, Appendix L). The flow rates for the 2-year and 25-year high-flow events are 156,000 and 297,000 cubic feet per second (cfs), respectively.

**Table 1. Estimated Lower Willamette River Flow Rates for High-flow Events**

Flood Return Period (years)	Flow Rate (cubic feet per second)
2	156,000
10	252,000
25	297,000
50	329,000
100	360,000
500	428,000

According to the flow rate data observed by the USGS gauging station (14211720) at the Willamette River at Portland, Oregon, the peak flow rates on February 1, 2003, and January 2, 1997, correspond to the 2-year and 25-year flood events, respectively (Figure 1). Predicted bed shear stresses at hourly intervals during a 3-day period of the floods (i.e., 1 day before and after peak flow rate) were extracted from a long-term sediment transport simulation that were transferred to EPA on September 14, 2011.

## **PREDICTED BED SHEAR STRESSES DURING THE 2-YEAR AND 25-YEAR FLOODS**

The following files contain the predicted bed shear stresses at hourly intervals during the 3-day period of flood, as well as the critical bed shear stress:

### ***LWR\_Sedtran\_longterm\_1008-02\_2-yr\_flood\_Tau.xlsx***

This file contains predicted bed shear stresses at hourly intervals during a 3-day period of the 2-year flood (i.e., January 31 to February 2, 2003). This file contains the following data fields:

- Time: month-day-year, hour : minute
- EFDC grid cell index I
- EFDC grid cell index J
- BEDMAP: bed property index (“0” represents cohesive bed, and “1” represents non-cohesive bed)
- Predicted bed shear stress in Pascal (Pa)

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- Note that hard-bottom grid cells, where no erosion and deposition occur, are excluded from this file

***LWR\_Sedtran\_longterm\_1008-02\_25-yr\_flood\_Tau.xlsx***

- This file contains predicted bed shear stresses at hourly intervals during a 3-day period of the 25-year flood (i.e., January 1 to January 3, 1997). The data structure in this file is similar to that in the 2-year flood file.

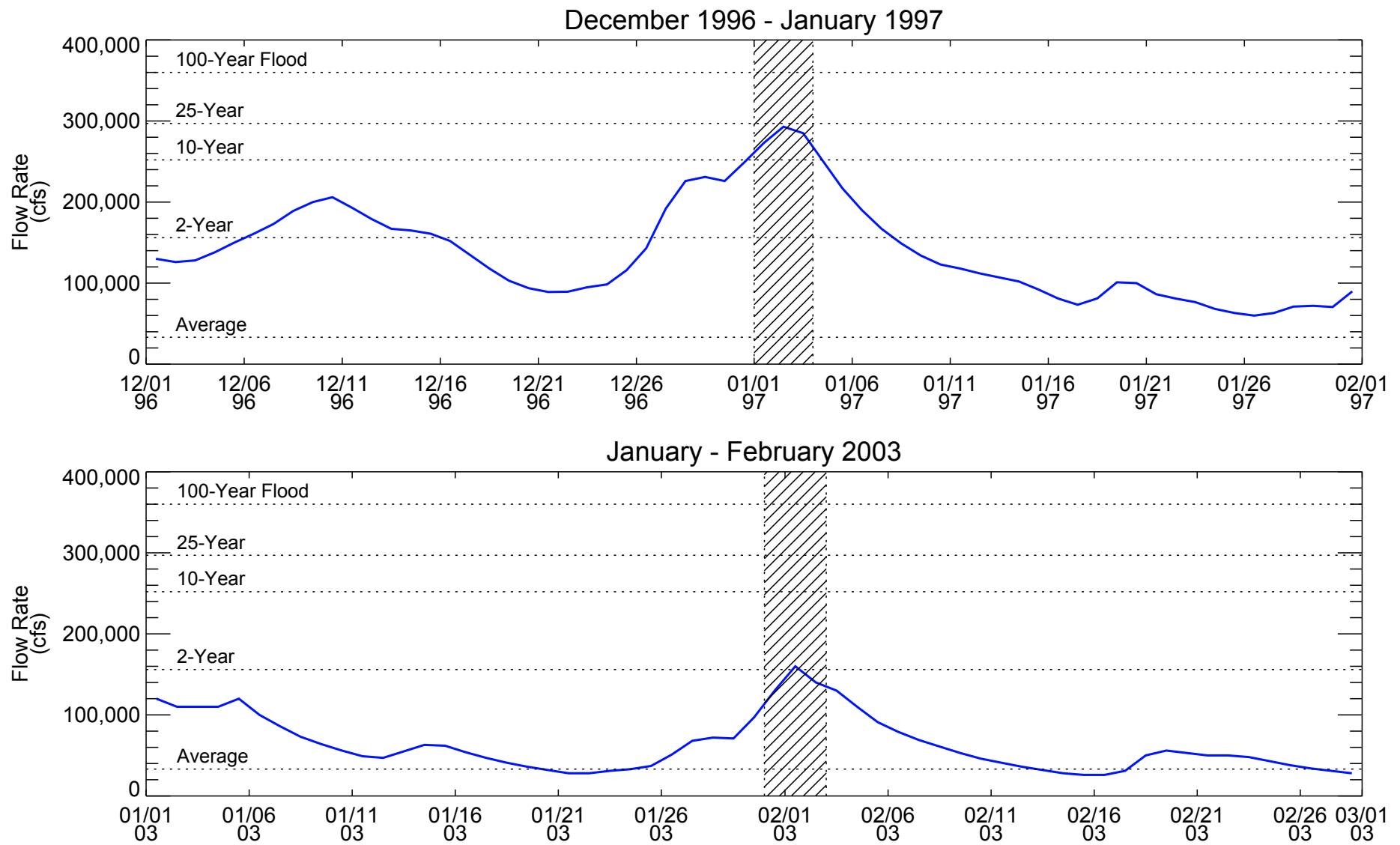
***LWR\_BED\_TAU\_CR.xlsx***

This file contains critical bed shear stresses (Pa).

- In the cohesive bed area (i.e., bedmap = 0), critical shear stress is 0.28 Pa, corresponding to the spatial average of Sedflume data at the 0 to 5 cm layer bed.
- In the non-cohesive bed area (i.e., bedmap = 1), critical bed shear stress is referred to the one for the initiation of bed load transport, which is a function of median sediment size class d50.

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**Figure 1**

Daily Average Flow Rates in Lower Willamette River for 2-year (2003) and 25-year (1997) Floods  
Lower Willamette River: Model Output Transfer to EPA  
Portland Harbor RI/FS